



Comparison of Some Nutrient Content of Sport Lawn under the Influence of Fertilizer and Seasons

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Abstract: Quantity, characteristics and composition of organic matter widely vary by changing seasons and geographical conditions. On the other hand when soil conditioning due to poor drainage limits then decomposition of organic matter by soil microorganisms highly reduces. Soil and plant testing is one of the best management methods in measuring these changes. In this study, the effect of seven types of organic fertilizer including Leaf Mold (LM), Rice Husk (RH), manure, Spent Mushroom Compost (SMC), a mixture of LM, RH and manure (mixture 1), a mixture of LM, RH and SMC (mixture 2) with the ratio of 1:1:1 and control (no fertilizer) at three levels of compaction including roller weighted at 36, 56 and 76 kilograms on some nutrient content of sport lawn were investigated in different seasons. An experiment was conducted as a strip plot design in three replications, in research farm of Gorgan University of Agricultural Sciences and Natural Resources during 2008-9. With the comparison of the total mean of leaf nitrogen and potassium in different seasons, the highest and the lowest absorption rate of these elements was observed in the fall and summer respectively. Moreover, statistical analysis indicated higher concentration of phosphorus in spring and summer than fall and winter.

Keywords: Lawn, bed, minerals, uptake.

1. Introduction

Lawns need sixteen mineral elements to maintain their survival. Major elements are naturally present in the soil, while three main elements nitrogen, phosphorus and potassium should be added to the soil regularly (Naderi & Kafi, 2005). The most essential elements needed for lawn is nitrogen (Fallahian, 2006). One of the common signs of nitrogen consumption in all lawn species is the increase of the vegetative growth rate and the creation of dark green color in lawns (Bell *et al.*, 2004). An increase in nitrogen causes the increase in root growth and the creation of rhizome and stolon. Balanced consumption of nitrogen causes the increase in wear tolerance, resistance to diseases and other environmental stresses and accelerating lawn recovery (Kafi & Kaviani, 2002). Excessive lawn growth caused by fast-release fertilizers can be

detrimental to lawn both from an agronomic and a disease standpoint. Providing a lawn nitrogen requirement with slow-release fertilizers, such as organic fertilizers, can be a solution to reduce this problem (Nus, 1997). Sewage sludge has been reported to produce lawn with less clipping yield than urea (Hummel & Waddington, 1981; Sartain, 1985). The use of organic fertilizers also resulted in fewer mowing and less total shoot growth compared to chemical fertilizers (Carey, 1997; Lettner *et al.*, 1997). Phosphorus in the process of respiration, formation and seed growth and rapid root development is very important and practically causes the increase in resistance to wear tolerance in lawns (Fallahian, 2006). With the decrease in pH and creation of complexes organic - metal, organic matters improve nutrient absorption such as phosphorus (Abdollahi, 2004; Keshavarz & Delavari, 2009; Samar & Malakoti, 1998; Norbakhsh, 2004;

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Kabiri Nezhad *et al.*, 2009). In the experiment of the influence of humic substance on rooting and nutrient content of *Agrostis Stolonifera*, the phosphorous concentration of plant in sand culture was increased 3 to 5 percent by incorporated humate and foliar application of soil, peat or leonardite derived HA (Cooper & Chunhua, 1998). Potassium is involved in regulating osmotic and turgescence pressure, stomatal opening and closing and activating enzymes especially those involved in photosynthesis and respiration (Rahimi, 2008). Shoot growth and stolons development during the establishment are improved by potassium intake (Kafi & Kaviani, 2002). Potassium is involved in the increase of wear tolerance and plant resistance to diseases and cold winter, firming texture and avoidance of lawn verse (Fallahian, 2006). Adding organic matter to soil causes the increase of cation exchange capacity and thus the increase of nutrient availability such as potassium (Kochaki & Khalghani, 1998). In an experiment to determine the effect of nutrient on wear tolerance of seven types of *Seashore paspalum* and three hybrid Bermudagrass cultivars, this characteristic was increased by the increase in potassium content of stem tissue (Trenholm *et al.*, 2001). Besides the positive effect of organic fertilizers in nutrient content of lawn, soil drainage and ventilation rate also play an important role in the growth, quality and nutrient uptake in this ground cover plant. Compact soil directly, with the decrease of root respiration and reduction of water and mineral uptake and indirectly by making the soil chemical conditions non-conductive disrupt nutrient absorption, of which all their symptoms show slow growth and symptoms of deficiency (Malakoti & Riaz Hamedani, 1991). In the current study, the effects of seven types of organic fertilizers along with three levels of compaction were evaluated on some nutrient changes of sports lawn during different seasons. Knowing changes in nutrient content in different seasons lets adopting better management strategies for lawn grounds.

2. Materials and Methods

Current research was conducted in two stages of field and laboratory, at research farm and laboratories of agronomic research at Gorgan University of Agricultural Sciences and Natural Resources during 2008-2009. The experimental design was a strip plot with three replications. Lawn used was sports lawn, seed mixture of *Lolium perenne* cultivar "Rival" (55 percent), *Poa pratensis* cultivar "Geronimo" (35 percent), *Festuca rubra* cultivar "Rubra" (5 percent) and cultivar "Apache" (5 percent). Organic fertilizers which were mixed to the topsoil surface included; leaf mold (LM), rice husk (RH), livestock manure, spent mushroom compost (SMC), a mixture of LM, RH and livestock manure (mixture 1), a mixture of LM, RH and SMC (mixture 2) with the ratio of 1:1:1 and control (no

fertilizer). In addition, three compaction treatments contained roller weighted at 36, 56 and 76 kilograms. The area of project land was 350m². After plowing, leveling and implementation scheme, the land was divided into 63 experimental units with dimensions of 2 × 2m² and the distance between the experimental units was considered one meter. Then organic fertilizers applied to the soil surface in a 3cm layer and incorporated with shovel to a depth of 10 to 15cm by the worker. At the end of each month, three compactness treatments were applied with a roller which its weight could be changed by adding or removing water to its tank. After planting seeds with the amount of 45gr/m², other lawn maintenance operation was conducted regularly and similarly in all plots. At mid different seasons samples of every plot were taken using a mower that its cutter blade set at 5cm above ground. The dry matter rate of different treatments was determined after drying fresh samples at 75-80⁰C for 48 hours (Adavi *et al.*, 2005). Plant samples were analyzed mainly to measure major nutrient elements including; nitrogen, phosphorus and potassium. To determine the nitrogen in plant tissues, Kjeldahl device was used (Emami, 1996). After the preparation of plant tissue extract, the amount of potassium and phosphorus were measured by flame photometer and spectrophotometer device respectively. (Aliehyai & Behbahani, 1993). Statistical analysis was performed with SAS software. Significant differences between means were determined by LSD test at the 5 percent level (Soltani, 2007).

3. Result and Discussion

3.1 Nitrogen

Nitrogen content in lawn leaf tissue has wide range and its rate depends on species, cultivar, sampling time, consumption of nitrogen and potassium fertilizers in the soil and maintenance operations of lawn (Kafi & Kaviani, 2002). With the comparison of the total mean of plant nitrogen in different seasons, the effect of season on this factor became significant, so that samples were taken in the fall and summer showed the highest and the lowest nitrogen content respectively (Fig. 1).

Undoubtedly nitrogen deficiency is considered one of the most popular deficiencies of nutrient elements in lawns. This issue is related to the high use of nitrogen in all lawn varieties especially in younger plants than older plants. On the other hand, because the nitrogen's holding power by the soil colloids is very low, so if nitrogen nourishment were ignored in lawns, deficiency symptoms would emerge faster (Kafi & Kaviani, 2002). In the current study, the presence of the highest nitrogen in young plants of fall than summer shows that lawns for beginning their growth and to be more succulence have a lot of need to this nutrient element. As initially mentioned, lawn maintenance operations

are another factor affecting the amount of leaf tissue nitrogen (Kafi & Kaviani, 2002). Hence in this study frequent mowing through seasons can be another reason for decreasing the amount of nitrogen in plant tissues. Since the temperature affects the mineralization rate of organic matter and mineral uptake (Norbakhsh & Karimian Eghbal, 1997; Haghnia, 1995), thus less nitrogen in plants grown in the cold winter than fall would be obvious. Numerous tests have shown that absorbing minerals by the roots in the number of plant species decreases at low temperatures of soil. This may be due to decrease in respiratory activity and reduction of cell wall permeability (Malakoti & Riazi Hamedani, 1991). Another reason for lower nitrogen in plants of summer could be attributed to soil moisture levels. Because when the soil moisture level is about field capacity, roots easily absorb significant amounts of soil nitrogen but in summer the plant roots get its needed moisture from deeper soils with less nitrogen so that lower nitrogen content will be observed in the plants of this season (Akef & Bagheri, 1999). Compact soil can disrupt nutrient absorption (Kafi & Kaviani, 2002). If soil drainage is optimum, decomposition will be conducted aerobically and protein found in animal and

plant residues decomposes to ammonium compounds. Then this material will be oxidized by nitrate maker bacteria and turns it to nitrate but if the oxygen supplied in a compact soil be restricted, denitrification or loss of soil nitrogen would be observed (Akef & Bagheri, 1999). So in the spring and summer due to continuous use of roller, less nitrogen was observed than fall and winter. These results about the relationship between ventilation and nitrogen rate are close to Norbakhsh's findings.

3.2 Phosphorus

A wide range of phosphorus concentrations (0.1-0.5 percent) have been reported in lawn leaf tissue. This rate besides lawn cultivar and species depends on sampling time of tissue too (Kafi & Kaviani, 2002). Hence in this study after applying fertilizers and compaction treatments, phosphorus concentration in leaves of sports lawn was measured in mid of each four season. Statistical analysis indicated higher concentration of phosphorus in spring and summer than fall and winter (Fig. 2).

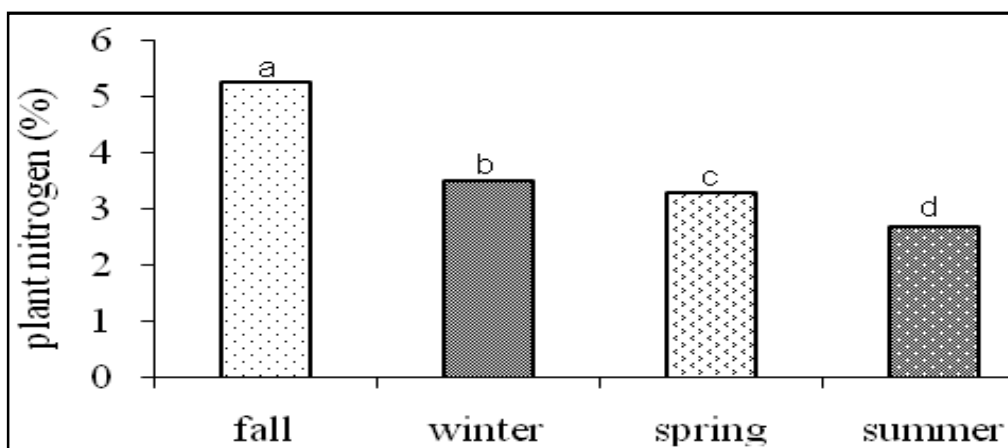


Fig. 1. Comparison of the plant nitrogen content in different seasons.

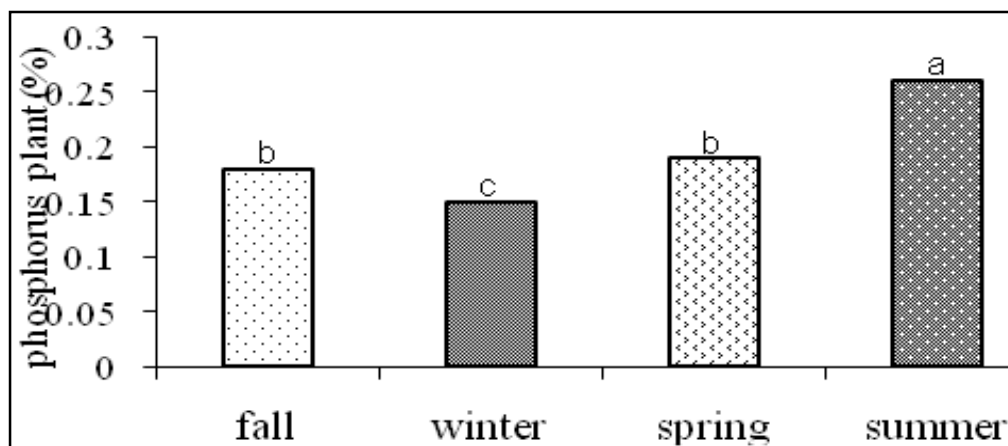


Fig. 2. Comparison of the plant phosphorus content in different seasons.

Phosphorus absorption by soil is similar to water absorption by a sponge. When a sponge absorbs a little water, extracting water from it is very difficult but if a sponge is saturated, water extraction would be conducted simply. The same process happens in the soil, it absorbs phosphorus strongly but as the soil gets close to saturated point, the power to keep phosphorus will be decreased and phosphorus absorption by plant root systems becomes easier every time (Akef & Bagheri, 1999). So since the amount of phosphorus measured in trial soil was close to its critical level, by adding organic fertilizer to the soil, its phosphorus was strongly absorbed by soil colloids (decrease of phosphorus in the fall) and after soil saturation of phosphorus, plant phosphorus was increased (increases of phosphorus in summer). Organic materials form the most significant storage for plant phosphorus. During the decomposition of this material, phosphorus will be available for plant (Kochaki & Khalghani, 1998). Since the appropriate temperature for organic material corruption is around 30°C (Malakoti, 1999), so it is obvious that more phosphorus will be available for plant in summer than fall. Also Forghani & Kalbasi, (1994) and Naghizadeasl *et al.*, (2009) reported that the amount of phosphorus absorbed by plant has a high correlation coefficient ($r=0.93$) with organic matter and soil pH. Decrease in PH leads to decrease of phosphorus fixation and increase in its availability. This result was reported by the application of compost in farmlands (Wright *et al.*, 2008). As mentioned before, absorbing minerals by the roots in the number of plant species decreases at low temperatures of soil (Malakoti & Riazi Hamedani, 1991). Since phosphorus is an immobile element (Mahmodi & Hakimian, 1995), slow movement and low temperatures of soil in fall than summer can be another reason for the lower levels of phosphorus in fall and winter than spring and summer.

3.3 Potassium

Sampling time during the year has a decisive role in the amount of potassium in lawn's leaf tissues. For

example, potassium level in Enmondi cultivar has been reported between 1.76 to 3.35 percent during a season (Kafi & Kaviani, 2002). Considering the important role of potassium in growth increase and lawn wear tolerance, the amount of this element was measured in fall, winter, spring and summer. With the comparison of the total mean of leaf potassium in four seasons, the highest and significant rates of potassium uptake were observed in fall in comparing with other seasons (Fig. 3).

Whereas the amount of potassium in trial soil was lower than the critical level (207.14 ppm), thus by adding fertilizer to the soil, potassium rates in the fall would be higher than other seasons. It is a major feature of potassium that is absorbed by plant tissues quickly (Abdollahi, 2004) but the amount of potassium absorbed by plants depends on the growth rate, development and the amount of root carbohydrate (Malakoti & Homaii, 2005; Marschner, 1995; Srinivasarao, 2000; Wright *et al.*, 2008; Handreck & Black, 1988). So the roots of young plants in the fall with more carbohydrate content had more speed in absorbing potassium than the mature plants in summer. Frequent mowing and no application of fertilizer can be another reason for the decrease of potassium content of plants in the summer (Naderi, 2005). Less compaction and thus more aeration in the fall is another reason for seeing more potassium content in this season. With the decrease of oxygen, root respiration and thus the nutrient uptake is reduced but the important point is that the absorption of all nutrient elements isn't reduced similarly. It can be proved that compacted soil reduces absorption of potassium more than phosphorus or nitrogen. A close research on corn showed that potassium uptake is more sensitive to soil ventilation than other macro elements (Mahmodi & Hakimian, 1995). Low potassium content of plants in summer confirmed the mentioned issue. Salardini, (1995) also showed that as the soil ventilation improves, the amount of potassium absorbed by the plants will be increased.

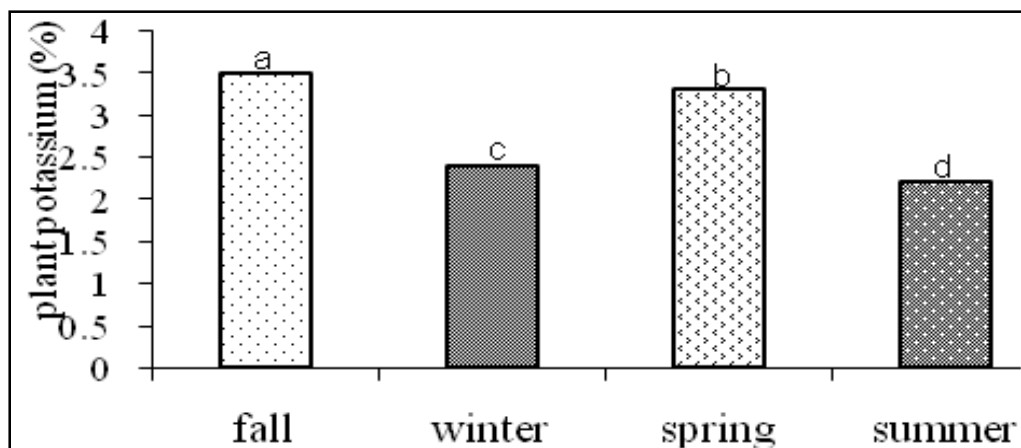


Fig. 3. Comparison of the plant potassium content in different seasons.

4. Conclusion

In different seasons, livestock manure treatment increased plant nitrogen more than other treatments. Livestock manure and SMC treatments indicated the highest plant potassium in all seasons, while the lowest plant potassium was observed in control and LM treatments. Also, in almost all seasons, livestock manure and SMC treatments and also treatments containing these two types of organic fertilizer (M1 and M2), had the most influence on increasing plant phosphorus than other treatments. The results of measuring each of mentioned factors were observed in the most compaction treatments. According to the results of the current study, each of bed mixtures including SMC or livestock manure can be suggested to improve the shortage of each mentioned elements in a particular season.

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